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DR. OTTO KLEMM, docent at Leipzig, has been appointed professor of psychology in Alberta University, Edmonton, Canada.

DR. KARL HESCHELER has been appointed professor of zoology and anatomy at Zurich, to succeed Professor A. Lang, who retires from active service.

PROFESSOR ALBERT BUSHNELL HART has been selected by the German government as Harvard exchange professor at the University of Berlin for the academic year 1914-15.

#### DISCUSSION AND CORRESPONDENCE

##### THE RELATIVE IMPORTANCE OF SULPHATES AND PHOSPHATES IN SOILS

It has been demonstrated by a number of investigators<sup>1</sup> that the total sulphur content of soils is generally low, the amount usually not exceeding 1,000 pounds in an acre surface foot. Further, it has been shown that an equal mass of soil will contain quite as much and very often a greater quantity of phosphorus. Another fact of equal importance and which has been abundantly demonstrated is that the demands for sulphur by farm crops is not appreciably less than for phosphorus.

No one familiar with this subject would question the necessity of maintaining the supply of phosphorus in a soil, but only lately has attention been focused on the sulphur problem, placing that element in the same category with phosphorus as an element of low supply and an economic factor in crop production and permanent fertility.

On the basis of "total" analysis it appears certain that the amount of sulphur in our common soils is not larger than the phosphorus supply, and, further, that the amount brought to the surface annually in the rainfall will not compensate for the loss the land sustains by drainage.

Yet when we admit these facts we have only opened the problem of the necessity of sulphur

fertilization. It is becoming rather common practise to attach a great deal of importance to the total quantity of any given essential plant food element in the soil, believing that this alone will measure or determine the permanent crop-yielding power of a given soil. For a measure of permanent crop production and for the knowledge upon which to build the soil to a certain plane of efficiency these determinations undoubtedly have value, but in the problem of continued fertilization too often we lose sight of the influence of the added material on the biological soil processes and the physiological balance of nutrients essential for the optimum growth of plants.

While it is admitted that the soil supply of sulphur is as low as the phosphorus supply, yet the question must be raised and answered—will sulphates influence crop production to the same extent as added phosphates?

It is apparent that part of the soil sulphur is in organic forms and part as sulphates, but that the organic forms are constantly being oxidized to sulphates. The additional fact that drainage waters are richer in sulphates than in phosphates must lead to the conclusion that the solubility of the sulphates in the soil water is much greater than the solubility of the phosphates. This being true, it is apparent that a lesser total quantity of sulphates in a soil would be as efficient in maintaining a sufficient sulphate concentration in the feeding zone of the plant as a much greater total quantity of phosphates.

In addition to the question of solubilities the important factor of the relative effects of sulphates and phosphates on the biochemical soil processes must be raised. Such important biochemical processes as ammonification, nitrification, nitrogen fixation, and the rate of decomposition of organic matter with its accompanying liberation of carbon dioxide can not be too greatly emphasized in deciding on the relative fertility of soils.

It has been demonstrated beyond question in certain phases of fermentology that cellular and enzymatic activities are markedly increased by the presence of soluble phosphates. Harden and Young have shown that the ac-

<sup>1</sup> Bogdanoff, Abstract Expt. Station Rec., 11, 723; Dymond, Hughes and Dupe, *Jr. Agr. Sci.*, 1905, 1-107; Hart and Peterson, Research Bull. No. 14, Wis. Exp. Station; Shedd, Bull. No. 174, Ky. Agr. Expt. Station.

tivity of the yeast cell or its zymase is greatly accelerated by the presence of these substances. The question then may properly be asked whether soluble phosphates do or do not accelerate the activity of the organisms or the enzymes responsible for those important soil processes mentioned above, and further whether sulphates effect in the same degree such accelerations.

Work in this and other laboratories has progressed far enough to indicate that soluble phosphates have a very material effect in increasing the number and consequently the rate of ammonification, nitrification, nitrogen fixation, and carbon dioxide output of those soil organisms capable of carrying out these processes, while sulphates do not, at least in the same degree, accelerate their multiplication. My thanks are due Professor C. Hoffmann for conducting such experiments.

From such results it is evident that sulphates will not be of the same importance in increasing crop production as can be expected from the phosphates. An adequate supply of sulphates is, of course, necessary, and for those crops making an abundant use of sulphur, such as the high protein plants and the members of the Cruciferae, a further concentration in sulphates of the soil water may often result in increased crop production. But to the phosphates must be ascribed functions additional to that of merely maintaining a certain concentration of phosphorus in the soil solution—namely, the important function of greatly accelerating the biological activities of the soil.

In conclusion, however, it should be emphasized that as crop production per unit of area increases through the extended use of added phosphorus and attention to proper soil reaction, there will result an increased demand for sulphur.

E. B. HART

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#### GRIZZLY BEARS: SKULLS WANTED

HALF a century ago a considerable number of wholly distinct species of grizzly bears inhabited the western part of North America. They ranged from the eastern edge of the

Great Plains in Manitoba and the Dakotas westerly to the Pacific coast in British Columbia and California, and from the shores of the Arctic ocean south into Mexico. The species inhabiting Alaska and the western provinces of Canada, though reduced in numbers, may still be counted among the living, but those of the western United States are with few exceptions extinct; and what is still worse, in most cases only a few skulls remain to afford future students a fragmentary and imperfect picture of the great carnivores which not long ago were dominant figures in our wild life.

For twenty-three years I have been engaged in a study of the bears, and have been favored with specimens (mainly skulls) from nearly all the museums and private collections of the United States and Canada. Still, owing to wide gaps in this material, many questions have arisen which can not be answered. Not only is it impossible to map the ranges of the different species with anything like precision, but in some cases, owing to the absence of skulls of adult males, the characters which serve to distinguish one species from another can be determined only in part.

Therefore, in the hope of obtaining more light on some of these questions before going to press, I wish to make a final appeal to all who have skulls of grizzlies in their possession. I am anxious to see as many skulls as possible of both sexes from all parts of the western United States, British Columbia, Alberta, Manitoba, Yukon Territory and Alaska, and would like to purchase or borrow all that I have not already seen. Owners of skulls will confer a favor by addressing

C. HART MERRIAM

NATIONAL MUSEUM,  
WASHINGTON, D. C.

#### QUOTATIONS

THE PARTICIPATION OF UNIVERSITY PROFESSORS  
IN POLITICS <sup>1</sup>

*My dear President McVey:* I regret to advise you that I find myself out of harmony

<sup>1</sup> Correspondence between the professor of law and the president of the University of North Dakota.